

C-5 Parts Shortages Imperil

US Power Projection:

Wasted Hours, Missing Parts, and Inaccurate Systems

Lower Military Readiness and Morale

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Introduction:

Today's military is called upon to carry out diverse missions around the world. In order to get the people and necessary equipment to those missions quickly, C-5 aircraft on the East Coast load up and fly out of Dover Air Force Base in Delaware. Without C-5s, this nation cannot effectively project power overseas and meet national security needs. Without repair parts, C-5s are not available to the nation.

It is hard to underestimate the importance of the C-5 to America's national security strategy. The C-5 is vital for getting military forces to major conflicts and to operations other than war, like humanitarian or peacekeeping missions. It is also vital for the sustainment of deployed forces. The best way to see that is to think of just a few examples of America's use of the C-5:

- Force Build-Up in Southwest Asia, November 1997-February 1998
- Embassy Bombing Relief and Transport of FBI Team, August 1998
- Medical Relief to Armenia as Part of Operation Provide Hope, July 1998
- Wildfire Assistance to Florida, July 1998
- Force Build-Up and Sustainment of Operations Over and Around Kosovo, January-July 1999
- Fairfax Emergency Search-and-Rescue Team traveled to Turkey and Taiwan to save lives after earthquakes, August and October 1999
- Operation Atlas Response to assist flood relief efforts in Mozambique, March-April 2000.
- Equipment and Supplies to aid earthquake victims in India, February 2001.

As the above examples make clear, it is the C-5 that makes it possible for the United States to use its military to handle both armed conflicts and humanitarian crises. If

the C-5s aren't flying, then neither are US military forces nor assistance.

In the past four years, Congress has increased funding for aircraft spare and repair parts. Unfortunately, that increased funding has not solved the problems facing the hardworking men and women at Dover and across the C-5 fleet.

Instead of replacing a broken part with a part off-the-shelf, maintenance crews are forced to cannibalize parts, that is, open up another C-5 aircraft and take parts from that plane. Not only does this mean double-to-triple the workload for maintainers, it also means that perfectly good airplanes are not available to fly because they are needed for parts. While we all know that this practice is necessary at different points, it should never be regular business practice. It's bad management of both supplies and manhours. Worse, it limits the availability of vital C-5 aircraft.

As I have seen this process of cannibalization become more and more the norm, I have become increasingly concerned. This report is an effort to bring attention to the problem and make a wider range of people aware of the things that I have learned while trying to understand the full scope of the C-5 parts problem. It is just one step in clarifying the problem and looking for solutions. I also authored legislation last year requiring the Secretary of the Air Force to provide Congress with two reports on the problem in 2001.

While this report specifically focuses on the C-5, the issues are common to older helicopters in the Army, older airplanes in the Navy and Marine Corps, and to other Air Force airplanes. Unfortunately, the C-5 provides one of the most complete case studies of all aspects of the complicated problems facing logistics support for the older aviation assets currently in our military.

Reducing the impact of these problems requires both long and short-term thinking. We know that some of the pieces of the solution for the C-5 include:

- increased and predictable parts funding,
- complete modernization of the entire C-5 fleet (including the High-Pressure Turbine Replacement, the Avionics Modernization Program, and the Reliability Enhancement and Re-engining Program), and
- continued management reform throughout the logistics system.

It is vital that we implement these pieces so that we have a healthy heavy airlift fleet to

promote American interests at home and overseas.

I am not the only person who has been concerned with these issues. Many of my colleagues in Congress have focused on this issue, particularly on the Armed Services and Defense Appropriations Committees in both chambers. In addition, there are many within the Department of Defense who are involved in a daily effort to fix these problems. In fact, as a result of all of our concern, earlier this year, the Air Force created a new system program office devoted solely to addressing the problems of Aging-Aircraft Systems.

There are some signs that these combined efforts by all of us are starting to have an impact, but they are very tenuous signs still. I hope that this report will help educate even more people and encourage others to join our efforts.

I am looking forward to continuing to work with the new Bush Administration, my colleagues in both parties, and with Department of Defense leaders to fix the array of problems that have contributed to the C-5 parts shortage. There are no silver bullets and there are no “one time only” solutions, so we must be vigilant and thorough in our approach to the problem.

Our global reach and security depends upon all of us working together to ensure that the long-term and short-term aspects of the C-5 parts problem are addressed. While logistics support for any military system is not necessarily glamorous, in the case of the C-5 it is essential. America’s ability to promote its interests around the world depends upon it.

Chapter I:

The Importance of the C-5 to National Security

In 1899, Winston Churchill said,

*Victory is the beautiful, bright colored flower. Transport is the stem without which it could never have blossomed.*¹

Today's transport of choice is airlift. Airlift is the quickest way to get people and equipment anywhere in the world. As the US military has downsized its overseas presence, the ability to rapidly mobilize and deploy forces overseas has become more critical,

*With fewer US forces present overseas, US National Military Strategy relies heavily on the fundamental concept of force projection, the military element of power projection.*²

Force projection simply cannot happen without airlift. Our ability to conduct all major theater operations is dependent upon being able to move assets into theater in time to meet the needs of our warfighters.

Airlift is a cornerstone of global force projection. It provides the means to rapidly deploy and redeploy forces, on short notice, to any location worldwide.³

¹ Winston Churchill, *The River War*, in, *Dictionary of Military and Naval Quotations*, Colonel (Ret.) Robert Debs Heinl, Jr. (Annapolis: United States Naval Institute, 1985), p. 330.

² Joint Pub 4-01.8, *Joint Tactics, Techniques, and Procedures for Joint Reception, Staging, Onward Movement, and Integration*, June 13, 2000, p. vii.

³ Joint Pub 4.01.1, *Joint Tactics, Techniques and Procedures for Airlift Support to Joint Operations*, July 20, 1996, pp. v & I-1.

The recently completed Mobility Requirements Study 2005 (MRS-05) has made it clear that the requirement for airlift is still growing. According to the executive summary, the military of 2005 will require 54.5 million ton miles per day of airlift to execute the current military strategy with moderate risk.⁴ Million ton miles per day is the measure used by the military to estimate the amount of cargo that must be moved on a given day to meet military requirements. Specifically, it is the ability to move one ton of cargo one mile in one day. MRS-05 defines a requirement that is 4.8 million ton miles per day larger than the current requirement of 49.7 million ton miles per day. According to General Robertson, Commander in Chief of United States Transportation Command and Commander of Air Mobility Command, the military is already 17%, or about 5 million ton miles, short of meeting that smaller, pre-MRS-05, requirement.⁵ The General Accounting Office (GAO) confirms these estimates, saying that the current shortfall will rise to 10.56 million ton miles total, or 31.1%, using the 2005 requirement.⁶

It is quite possible that the Quadrennial Defense Review (QDR), to be completed in 2001, or the strategic review being undertaken by the new Administration, will establish a new military strategy other than the current strategy of fighting two nearly simultaneous wars (2 MTWs). However, as various different strategy scenarios (for example, multiple smaller contingencies and one major theater war) have been reviewed by the Pentagon in preparation for the next QDR, the military has realized that it will need more airlift even if the national military strategy is changed⁷.

There are several reasons why a new strategy would not significantly reduce the heavy airlift requirement of the military. First, because we have a reduced number of bases overseas. Today, American planes only have access to 12 major air bases around the world while en route to potential conflict areas, compared to 45 in 1991.⁸ Second, the military

4 Joint Chiefs of Staff, *MRS-05 Executive Summary -- Unclassified*, January 2001, p. 4.

5 Christian Lowe, "Military Not Able to Meet Airlift Requirement for War," *Defense Week*, December 18, 2000, p. 1.

6 General Accounting Office (GAO), *Military Readiness: Updated Readiness Status of U.S. Air Transport Capability*, GAO-01-495R, Update to House of Representatives, Committee on Armed Services, Chairman of the Subcommittee on Military Readiness, March 16, 2001, p.12.

7 Discussions with several senior Air Force leaders in March 2001.

8 Major General Arthur Lichte, Director of Plans and Programs, Air Mobility Command, briefing to Congressional staff, August 10, 2000.

has a more expeditionary posture today. For example, the Air Force wants to be able to move five AEFs in 15 days (Aerospace Expeditionary Forces -- these are the forces that stand ready to respond to new or on-going contingency operations on a rotating basis).⁹ Both of these developments mean that more airlift is required to get the military and its equipment in place and to keep deployed troops fully supplied.

Third, new concerns, like the increased potential for chemically or biologically contaminated environments, make it more possible that the military will not be able to rely on the commercial aircraft fleet for as much support as in the past. Once again, this increases the need for military airlift. Consequently, given the current operating environment, even if the national strategy is changed, the C-5 will continue to be crucial to America's efforts to shape the international environment for the foreseeable future.

C-5 Capabilities and Mission

For decades now, the C-5 has been the mainstay of our outsize/oversize airlift fleet. Outsized/oversized cargo is cargo that is too large or heavy to go on commercial aircraft or smaller military aircraft. It can only be carried on C-5s or C-17s. Equipment like tanks or Patriot missile batteries fall into this category. In 1999, the C-5 provided 50% of the military's airlift capability (13.0 out of 25.9 million ton miles per day).¹⁰ For the rest of its current airlift requirement, the military contracts with civilian aircraft as much as possible.

The C-5 is able to move more cargo, over a greater distance, than any other aircraft in the military fleet. Using its current 43,000 pound thrust engine, the C-5 can take a maximum of 291,000 pounds of cargo anywhere in the world.¹¹ It has a large cargo space of 121 feet, allowing it to hold 36 military pallets and to fit other outsized equipment without disassembly being required. This makes a difference to troops waiting to use equipment and vehicles, because they are ready to go much sooner after delivery if reassembly time is

⁹ GAO, *Military Readiness*, p.2.

¹⁰ Air Mobility Command, *Air Mobility Strategic Plan 2000, Volume 3: Air Mobility Modernization Plan (AMMP)*, "C-5 Roadmap Description," November 1999, cd-rom.

Unless otherwise noted, given statistics and funds are for Fiscal Years, not calendar years.

¹¹ Major General Arthur Lichte, Director of Global Reach Programs for Air Force Assistant Secretary for Acquisitions, U.S. Air Force Headquarters, "The C-5 Galaxy: Engine Analysis," briefing to Biden staff, March 23, 2000.

kept to a minimum.

To put it in more familiar terms, the C-5 cargo compartment is about the size of a football field. It can carry 100 Volkswagen Beetles at one time. With a single load of fuel, the C-5 can get from Los Angeles, California to Manila, Philippines in only 12 hours.¹²

The primary mission of the C-5 is strategic airlift. Strategic airlift is the movement of people and cargo from the continental United States (CONUS) to theaters of operation around the globe and movement within CONUS. Strategic airlift performs six key roles¹³:

- Deploy forces from the continental US to a theater or between theaters
- Sustain deployed forces
- Redeploy forces
- Conduct aeromedical evacuation operations
- Augment theater or special operations airlift capability
- Conduct noncombatant evacuation.

C-5s from Dover Air Force Base are also used for airdrop and Special Operations missions.¹⁴

The C-5's capabilities are uniquely important in wartime because of the kinds of forces it can deploy – 70% of the cargo most needed by warfighters in the first 30 days of a conflict, the halting phase, can *only* be moved in a C-5 or C-17.¹⁵ In other words, outsized/oversized strategic airlift is vital to the first 30 days of combat. In

¹² Air Mobility Command Museum, "C-5 Points of Interest" Fact Sheet, Dover Air Force Base, Delaware, 1999.

¹³ Joint Pub 4.01.1, p. II-1.

¹⁴ Dover Air Force Base web site <<<http://www.dover.af.mil/org/index.htm> >>, 436th Air Wing Mission and Organization, viewed July 17, 2000.

¹⁵ General Charles T. Robertson, Jr., Commander in Chief, United States Transportation Command and Commander, Air Mobility Command, "Global Mobility – The Keystone to America's Defense Strategy," *The Atlanta Papers*, Final Proceedings of Rapid Global Mobility in the 21st Century Conference, Center for International Strategy, Technology, and Policy, Georgia Institute of Technology, January 27-29, 1999, p. 62.

addition, the C-5 is the only aircraft that can carry some military items, like one of the Navy SEALs special operations boats, a submarine rescue vehicle, and an Army mobile-bridge layer.¹⁶

Today, to repeat, there is a shortfall in outsized/oversized airlift.

*Yet the Balkan air action, for all its successes, also underlined an unpleasant truth: The Air Force simply doesn't have enough airlift to support US forces should they be called on to fight and win two Major Theater Wars in close succession – the benchmark of national strategy.*¹⁷

That conclusion and its implications were the subject of a June 2000 General Accounting Office Report. The report found,

*DoD does not have sufficient airlift and aerial refueling capability to meet the two major theater war requirements. . . . While the shortfalls do not mean the United States cannot win two major theater wars, the Office of the Joint Chiefs of Staff estimates that due to airlift shortfalls, military forces would arrive later than originally planned, thereby increasing the risk that war plans would not be executed in a timely manner and possibly increasing casualties.*¹⁸

The shortfall in outsized/oversized strategic airlift means increased risk for military personnel and missions. This is because critical equipment will be late to the battle. For example, if we have the expected airlift shortfall of 4,753 tons per day, that means that in the first 30 days of a conflict the following items will be missing:

- 1 Light Infantry Division,
- 1 Airborne Brigade,
- 3 Attack Helicopter Battalions, and

¹⁶ Seena Simon, "Plan for Costly Upgrade of Aging C-5s Questioned," *Air Force Times*, October 30, 2000, p. 18.

¹⁷ John A. Tirpak, "Airlift Reality Check," *Air Force Magazine*, December 1999, p. 32.

¹⁸ General Accounting Office (GAO), *Military Readiness: Air Transport Capability Falls Short of Requirements*, GAO/NSIAD-00-135, Report to the House of Representatives, Committee on Armed Services, Subcommittee on Military Readiness, June 2000, pp. 5-6.

- 3 Fighter Squadrons.¹⁹

These assets are vital to the men and women who are put in harms way. Delayed arrival increases the risk to these troops and to the ultimate goal of victory.

Ground troops are not, however, the only ones dependent upon heavy lift. Heavy lift is also critical for primarily air operations. For example, operations over Kosovo required over 1,450 C-5 sorties from February through July of 1999.²⁰ Twenty percent of the strategic airlift missions flown in support of Kosovo were flown by C-5s.²¹ The C-5 was an instrumental part of Allied success as it moved vital cargo, particularly precision munitions, into Europe as needed. This recent example makes it clear again that global force projection simply cannot happen without strategic airlift.

General Robertson stated the C-5s importance clearly in October of 1999,

This aircraft, important to every peacetime deployment we undertake today, is even more critical in an MTW [Major Theater War] scenario where we would be required to move significantly more unit equipment from CONUS [continental US].²²

In addition to the warfighting mission, the C-5 projects American power through the assistance it can deliver. It is a critical component of America's efforts to promote stability and peace around the world through humanitarian assistance operations.

The C-5 is the only plane that was capable of carrying the Fairfax Emergency Search-and-Rescue Team all the way to Taiwan, non-stop, with all of their

¹⁹ General Robertson, "Global Mobility -- The Keystone to America's Defense Strategy," p. 62.

²⁰ Air Staff, reply to Senator Biden inquiry, July 1999.

²¹ General Charles T. Robertson, Jr., Commander in Chief United States Transportation Command, written testimony to Subcommittee on Military Readiness of House Armed Services Committee, October 26, 1999, from <<www.house.gov/hasc/testimony/106thcongress/99-10-26robertson.htm>>, p.4.

²² Ibid.

equipment (weighing 56,000 pounds)²³ to save lives after the October 1999 earthquake. In August of that same year, the team flew on a C-5 to reach earthquake victims in Turkey.

Closer to home, in the summer of 1998, the C-5 helped provide assistance to those fighting Florida's raging wildfires. In March of 2000, C-5 crews flew over 120 sorties in support of Operation Atlas Response, which provided relief efforts after the flooding in Mozambique.

As the Air Force said in May of 1999,

*The C-5 is long recognized as a national asset because of its unique ability to move outsize and oversize payloads. As such, modernization funding delays will delay arrival of critical Outsize and Oversize equipment to the warfighting CINCs [Commanders in Chiefs] and severely impacts his ability to prosecute the conflict during the early days of the halting phase. This in turn significantly reduces the Air Force's ability to deploy joint combat forces to the theater as well as support joint UN humanitarian efforts worldwide.*²⁴

A healthy C-5 fleet is the basis for military force projection and for providing global humanitarian assistance. General Robertson has stated his belief that much of the current airlift shortfall is due, in large part, to neglecting the C-5, particularly its modernization and parts needs.²⁵

The Air Force and independent analysts believe the C-5 has the structural life to successfully continue to do its mission until the year 2040.²⁶ To take advantage of that structural life, the C-5 must have an adequate supply of parts, get modern avionics, and get new engines.

23 James Merriweather, "Team to Depart from DAFB," *News Journal*, August 18, 1999, p. A2.

24 Air Staff, Official Air Force Position, "Issue Paper: Congressional Marks (SAC-D) on C-5 Modernization," May 27, 1999.

25 General Robertson, "Global Mobility – The Keystone to America's Defense Strategy," pp. 61-62.

26 Major General Nick Williams, Director of Plans and Programs, Air Mobility Command, "Mobility Modernization," briefing to Biden staff, Scott Air Force Base, April 8, 1999.

Quite simply, the success of our military and the promotion of America's interests depends upon keeping the C-5 fleet healthy.

Chapter II:

C-5 Parts Shortages Lower Readiness and Morale

Inadequate spare parts for the C-5 has two primary adverse impacts – overworked maintenance personnel and lower mission capable rates, which means lower readiness and morale.

Overworked Maintenance Personnel and Lower Morale

In a December 1999 article, Chief Master Sergeant of the Air Force, Frederick J. “Jim” Finch explained,

When a decision was made some years ago to reduce spending on spare parts to apply the money toward other problems, ‘we were expecting to take a little hit on readiness,’ he said. ‘But what we really found was that spare parts, while you think about it from a readiness standpoint,...is really a quality-of-life issue.’ That is true because, despite the lack of parts, ‘our people still wanted to get the job done.’ That forced them to ‘steal the parts from one aircraft to fix another,’ doubling their workload.’²⁷

High cannibalization rates for an aircraft means that maintenance personnel are forced to do large amounts of extra work to fix an aircraft. In fact, cannibalizing parts from one aircraft to fix another does more than double the workload. Maintenance personnel must spend hours removing the part from the “cann-bird” (as planes used for parts are called). During the removal, there is a constant danger that the part will be damaged. The part is then put into the waiting plane in need of the particular part. Later, at some point, a replacement part must be found and installed in the cann-bird.

²⁷ Otto Kreishner, “A Talk With Chief Finch,” *Air Force Magazine*, December 1999, p. 65.

From 1997 to 1999, cannibalization rates for the C-5 steadily increased.²⁸ These rates appeared to be stabilizing in 2000 – the range is between 42.7 and 72.2 cannibalizations per 100 sorties.²⁹ This means that for every 100 sorties made by C-5s, an average of 42 to 72 parts had to be taken from another plane to make those flights happen. Unfortunately, this is still significantly above the Air Mobility Command goal that all of their aircraft have only 19.6 cannibalizations per 100 sorties or even the specific goal for the C-5 fleet to only have 31 cannibalizations.³⁰

When the General Accounting Office looked at the impact of cannibalizations on personnel working on three aircraft (the B-1B, the F-16, and the C-5) at two commands, their findings based on 1997 and 1998 were astounding:

Significant personnel resources were used to remove parts from B-1B, F-16, and C-5 aircraft and to put those same parts on other aircraft in order to keep them mission capable. . . maintenance personnel time involved in this practice equated to about 43 people working 8 hours a day, 5 days a week for 2 years.³¹

Closer to home, at Dover Air Force Base, from 1997 to 1999 the average manhours required for cannibalizations was between 800 and 1,000.³² Those are additional hours, above what is normally expected to replace a part. If that is put in terms of a 5 day, 40 hour work week, that's one person working 20 to 25 additional weeks of

28 Brigadier General Chuck Johnson, Director of Logistics, Air Mobility Command, "C-5 Weapon System," briefing to Biden staff, Scott Air Force Base, April 8, 1999.

29 F. Whitten Peters, Secretary of the Air Force, *January 2001 Report on Status of the Spare and Repair Parts Program of the Air Force for the C-5 Aircraft*, Report to Congress, p.4. The full text of the report is included in the appendix with the permission of the Senate Committee on Armed Services.

30 Ibid.

31 General Accounting Office (GAO), *Air Force Supply: Management Actions Create Spare Parts Shortages and Operational Problems*, Report to the Chairman, Subcommittee on Military Readiness, Committee on National Security, House of Representatives, GAO-NSAID-AIMD-99-77, April 1999, pp. 5 and 7.

32 436th Logistics Group slide, prepared for GAO, briefing to Biden staff, June 30, 2000.

work, over two years.³³

Another example from Dover of the extra manhours needed is the time it takes to get a cann-bird back into service after its been used as a cann-bird. In 1997 and 1998, 10 to 15 maintenance personnel worked 12 hour shifts for 10 to 14 days every time a cann-bird was being returned to flying status.³⁴ Cann-birds were brought back to flying status 8 times in a year. All of these measures show that an extraordinary amount of personnel time was added to the norm for maintenance and repair work.

No matter how dedicated our maintenance people are, they cannot be pushed this hard for years on end. Not having parts creates intolerable working conditions for them. One of the biggest retention challenges the Air Force, and the rest of the services, has today is with maintenance personnel.³⁵ These professionals will only stay in the military if they are given the proper tools to do their job.

It's not just maintainers whose morale falls in this inefficient and excessive workload environment. Lack of parts and high cannibalization rates also means fewer planes are actually able to fly. It also means that training hours get cut.

For example, during Fiscal Year 1998, B-1B and F-16 aircrews only flew 83% of the hours they were supposed to fly for training.³⁶ The C-5 has also been hit by this problem. This problem is not as dramatic as with combat aircraft because even in peacetime the need for C-5s is significant, so flying hours are primarily accrued in regular missions rather than primarily in training. Pilots do report that qualifications for some skills, like midair refueling at night, have become more

33 Since the original data only provides the two year average from 1997 to 1999, and not a year by year average, I extrapolated the additional weeks of work for two years (average additional hours divided by hours in a week). A one-year extrapolation (i.e., 10 to 12.5 extra weeks of work per year if the two year average is halved) risks being untrue to the original data since one of those years might have had significantly more or less extra manhours required for cannibalizations.

34 GAO, *Air Force Supply*, p. 24.

35 General Michael E. Ryan, Chief of Staff of the Air Force, and F. Whitten Peters, Secretary of the Air Force, *Posture Statement 2000*, p. 48.

36 GAO, *Air Force Supply*, p. 27.

difficult to maintain and acquire.³⁷

General George T. Babbitt, when he was head of Air Force Material Command, summarized the problem before the House Armed Services Committee's Subcommittee on Military Readiness,

*I, like many of you, have heard pilots and mechanics express their frustration over spare part shortages and the resulting extra work and lost training. At least half of the decline we've seen in mission readiness is a result of delays caused by the lack of immediately available parts.*³⁸

Lower Mission Capable Rates and Readiness

The complete impact of missing C-5 parts cannot be understood without looking at one of the Air Force's key readiness indicators – mission capable rates. The mission capable rate (MC rate) for an aircraft is a measure of the aircraft's reliability. The rate reflects how often a plane is able to take-off to do a mission. If an aircraft is judged to be not mission capable because of a lack of parts, then it is Not Mission Capable, Supply (NMCS). If it is not mission capable because of delays in actually doing the maintenance (i.e., if there are not enough personnel available), then it is Not Mission Capable, Maintenance (NMCN). The military tracks both so that it can better understand any lowering of mission capability.

From Fiscal Year 1990 to 1998, the average mission capable rate for Air Force major aircraft steadily declined from 84.6% to 74.3%.³⁹ Again, as General Babbitt pointed out, half of this decline was the result of missing parts. In keeping with this Air Force-wide trend, the C-5 mission capable rate has declined.

37 Biden staff conversations with Dover Wing Commanders and pilots stationed at both Dover Air Force Base and Travis Air Force Base.

38 General George T. Babbitt, Commander Air Force Material Command, verbal testimony to Subcommittee on Military Readiness of House Armed Services Committee, hearing on *Spare and Repair Parts Shortages*, October 7, 1999, Federal Document Clearing House, Inc. Transcript, p. 10.

39 GAO, *Air Force Supply*, p. 21.

In Operation Desert Storm, C-5 mission capable rates were at 75% or higher.⁴⁰ In the Fall of 1995, the GAO reported falling C-5 mission capable rates and identified key causes. After looking at Air Force records from 1992 to 1995, they concluded that significant parts shortages were impacting the C-5 fleet mission capable rates,

*In recent years, between one-quarter and one-half of the C-5 total not mission capable time was due to the lack of spare parts.*⁴¹

At that time, the Department of Defense response was that they were taking actions to increase C-5 spare parts funding and that,

*Due to the lead times associated with the procurement of spare parts, the return on investment for procuring spare parts occurs over a four year period (8 percent, 25 percent, 38 percent, and 29 percent, respectively). Consequently, the increased spare parts funding in FY 1995 will not visibly impact parts availability and the C-5 NMCS rate until FY 1997.*⁴²

Despite the GAO warning and apparent commitment by the Defense Department to fix the shortages, the problem did not go away in Fiscal Year 1997. In September 1998, this was the Air Staff answer to my question, “To what extent has inadequate parts supply affected C-5 reliability?”

*Overall, the lack of spare parts on the shelf at base level is hampering our ability to meet mission requirements. Lack of spares is a continual problem that seriously impacts mission readiness.*⁴³

Looking at the recent past, it is clear that the problem is still here. From 1997 to 1999, the Total Non-mission Capable, Supply (TNMCS) rates for the C-5

40 General Accounting Office (GAO), *Strategic Airlift: Improvements in C-5 Mission Capability Can Help Meet Airlift Requirements*, Report to the Chairman, Subcommittee on Military Readiness, Committee on National Security, House of Representatives, GAO-NSAID-96-43, November 1995, p. 3.

41 Ibid, p. 2.

42 Ibid, p. 19.

43 Air Staff, follow-up questions answered from 24 August 1998 Biden staff briefing, September 25, 1998.

continued to increase.⁴⁴ That trend continued through 1999 and only began to stabilize in 2000, when the last 10 months (and excluding February) the range was between 21.6% and 18.2%.⁴⁵ This is still double the command goal of 8.5%, but closer to the C-5 fleet goal of 15.2%.⁴⁶

What do all of those numbers mean? It means that C-5s increasingly carry a higher risk of developing problems during missions or that they are not available for the missions themselves – regular supply missions for forces already deployed, deployment of new military forces into conflict, training for aircrews, or humanitarian missions – because they do not have the parts they need. It also means retention and recruitment problems will persist because of low morale for maintenance personnel and aircrews.

The C-5 parts problem has lowered military readiness and morale. It has made the promotion of America's national interests more difficult and more risky.

44 Brigadier General Johnson, "C-5 Weapon System."

45 Secretary Peters, *January 2001 Report*, p.3.

46 Ibid.

Chapter III:

Aging Aircraft, Funding Priorities, and Restructuring Problems Created the Parts Shortages

C-5 parts shortages are primarily the result of three things – it is an aging aircraft; its funding was not properly prioritized; and there were maintenance system changes that were not entirely successful, along with management failures.

Aging Aircraft Have Parts Problems

The C-5 fleet is comprised of 76 older A-models and 50 newer B-models. The A-model first became operational in 1969. Its average age is approximately 29 years. The B-model became operational between 1986 and 1988. Its average age is approximately 13 years.⁴⁷ In order to be operational in 1969, the A-model was designed in the early 1960s, so it uses technology that is almost 40 years old.

As an older aircraft, effective management of parts is absolutely critical, but much more challenging. As systems age, forecasting which parts will require replacement or repair is difficult because there is limited data, or, in many cases, no data on the effects of aging on those systems. Typically, the commercial sector has moved into new technologies, so they do not have old aircraft in their fleet. In many cases, the aircraft or its systems were specially tailored for military requirements. For these reasons, the only sources for data with which to try to forecast problems are the military's inventory.

In addition to the lack of historic data, the Air Force and Defense Department are still using old and out-dated information management systems. This has created even more forecasting problems as attempts to adopt industry practices (like “just in time” inventory) have failed because of a lack of investment in industry

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Air Staff, briefing to Biden staff, August 24, 1998. 2 years were added to both estimates of average C-5 A and B age to reflect the passage of time since that briefing.

management and forecasting tools.⁴⁸ These factors all contributed to the Air Force's decision this year to set up a new program office for Aging Aircraft Systems.⁴⁹

The problems with older aircraft are particularly clear if you look at the example of one C-5 system, the engines.

*Nothing has been as great a challenge for effective spares management as jet engines. The C-5, B-1, F-15 and F-16 aircraft have been particularly hard hit.*⁵⁰

The C-5 uses a TF-39 engine. It was developed in 1964 as the world's first high bypass ratio engine, with a thrust of 43,000 pounds.⁵¹ Both C-5 A and B-models have the same engine. Right now, problems with the TF-39 account for over 20% of the C-5 not mission capable time.⁵²

Since the TF-39 was developed, commercial aircraft engine technology has improved by leaps and bounds. By some estimates, the commercial sector is five generations beyond the TF-39.⁵³ Those improvements to jet engines are important for two reasons. One, parts are no longer easily available for the older engines, particularly since there are no longer commercial customers. It can take from 18 to 24 months to get parts for the engines because the suppliers long ago stopped making some of

48 Draft C-5 Tiger Team results, as presented at the Airlift/AirTanker Association Convention, November 3, 2000, also highlighted this problem.

49 Jim Mathews, "USAF Opens Aging-Aircraft System Program Office," *Aerospace Daily*, February 12, 2001, p. 232.

50 General George T. Babbitt, Commander Air Force Material Command, written testimony to Subcommittee on Military Readiness of House Armed Services Committee, hearing on *Spare and Repair Parts Shortages*, October 7, 1999, <<www.house.gov/hasc/testimony/106thcongress/99-10-07/babbitt.htm>> p. 3.

51 Karl W. Matson, General Manager, Military Transport Engine Programs, GE Aircraft Engines, "C-5 Propulsion Update," briefing to Biden staff, December 14, 1998.

52 Air Mobility Command, *Air Mobility Strategic Plan 2000*, cd-rom.

53 Karl Matson, "C-5 Propulsion Update."

those parts.⁵⁴ This means that new suppliers need to be found, or depots need to construct the parts themselves.⁵⁵

Two, these older engines require far more maintenance time because of the way they are designed. Newer engines incorporate 40 years of experience with large engine design and reflect substantial design improvements. The way in which they operate makes them much more reliable and easier to maintain.

New, modern engines for the C-5 solves these problems. Supply needs can be better forecast with new engines. In addition, new engines would not require as much maintenance time and have existing supply sources for parts.

The same is true for other older subsystems within the C-5. While the Air Force still believes that the C-5 is structurally sound to fly for the next 30 to 40 years (another 30,000 hours),⁵⁶ its operating systems, like the engines, are old and, therefore, difficult to support. A comprehensive modernization program that includes new, commercial-off-the-shelf engines, discussed in more detail in the next chapter, will improve those systems and lower the demand for difficult to obtain C-5 parts.

Improper Funding

Another factor in the C-5 parts shortage has been the funding prioritization within the Air Force for Air Force Material Command. From 1991 to 1998, with the exception of one year, spare parts did not receive the funding necessary to meet each year's requirements.⁵⁷ Underfunding the requirement meant that parts were not purchased and were not available.

In February of 2000, General Lyles, Vice Chief of Staff of the Air Force, also made

54 General Babbitt, verbal testimony, October 7, 1999, pp. 18-19.

55 According to C-5 Program personnel at Warner-Robins Air Logistics Center, who met with Biden staff on June 24, 2000, this is also true of other parts for the C-5. In some cases, due to the large metal work that is included on the plane, entire machines have to be made in order to produce parts that have not been produced in 30 years.

56 Seena Simon, "Fuselage Cracks Appear Throughout Galaxy Fleet," *Defense News*, December 18, 2000, p. 44.

57 GAO, *Military Readiness*, p. 15.

the point that the C-5 was not the only victim. Throughout the Air Force, underfunding created spare parts shortages and lowered readiness.

*Spare parts shortages, arising from the constrained budgets of the 1990s, were a major contributor to the Air Force's readiness decline over the past several years.*⁵⁸

Overall Air Force spending on spare parts was also simply too low in 1996, 1997, and 1998. In those years, only 90%, 82%, and 94% respectively of the needed funds were obligated to spare parts.⁵⁹

For the C-5 in particular, the General Accounting Office points out that only 76% of repair parts were funded in 1994, 100% in 1996, but back down to 80% in 1997.⁶⁰ Meaning that there was no money available or programmed to meet 20% of the known, existing requirement.

Anything below 100% funding and spending creates a particular problem in the inventories of parts that tend to be more expensive, but lower demand. This is true because supply managers tend to make choices to help more customers with fewer dollars. At all levels of the defense logistics system (from basic parts stocked by the Defense Logistics Agency that are used to repair more specialized parts, to parts orders for specific weapons), this has been true.⁶¹

To understand this tendency better, think about a simplified example -- if a supply manager only has \$100 and he can either buy one part for a C-5 engine or 100 bolts for other aircraft, the tendency had been to buy the 100 bolts. This fails to properly account for the overall fleet needs of the National Command Authority at

58 General Lester L. Lyles, Vice Chief of Staff of the Air Force, written testimony before the Subcommittee on Military Readiness, House Armed Services Committee, February 29, 2000, from <<www.house.gov/hasc/testimony/106thcongress/00-02-29lyles.htm>>, *Washington Post*, 2/29/00, p. A01. Appendix (O) H E H Ç è â Z Ö ã ñ 6 Times ß New ß Roman ß Regular ã ã ^ ã Colonel James Russell, Air Mobility Command Headquarters Logistics Group, "C-5 Tiger Team

59 General Babbitt, written testimony, p. 7.

60 GAO, *Military Readiness*, p. 15.

61 Ogden Air Logistics Center personnel, Biden staff discussions, Hill Air Force Base, Utah, July 6, 2000.

that time or for the foreseeable future. In other words, for missions in which there are a large number of aircraft capable of doing the mission, like the C-130 fleet which includes approximately 700 aircraft, the impact on overall airlift capacity of losing one or two of those aircraft will be less than losing one or two C-5 aircraft, of which there are fewer. Since there are only 126 C-5s, losing just one plane unexpectedly, due to a parts shortage, degrades the national capability to move outsized/oversized cargo, which can only be moved on C-5s and C-17s.⁶²

Just in the month of April 2000, the Defense Logistics Agency (DLA) was only able to supply 85% of the C-5 parts requested from them.⁶³ DLA is responsible for approximately 75,000 items that are used on the C-5. Air Force Material Command, through the logistics centers, manages another 2,800 items unique to the C-5.⁶⁴

DLA's difficulties in providing high-priority C-5 items (items that are needed within two-days), led the Air Force and Department of Defense to contract with Lockheed-Martin to supply over 11,000 C-5 parts.⁶⁵ The Air Force expects this privatization to improve the speed of delivery of those parts and to allow for better parts tracking within six months.⁶⁶

Adding to the problem of how to allocate too few dollars was the tracking system being used to make inventory decisions. In general, if a part had not been ordered within the prior two-years, then it was removed from inventory.⁶⁷ This meant that many C-5 parts that were prone to breaking after three or five years, were no longer

62 The military's current plan is to procure 134 C-17s total, but the increased airlift requirement from MRS-05 makes it clear that more C-17s will be required to compliment fully modernized C-5s. C-17s can carry approximately half the cargo C-5s can carry and are replacing the C-141 fleet.

63 Warner-Robins Logistics Center, C-5 Program personnel, Biden staff discussions, Robins Air Force Base, Georgia, June 24, 2000.

64 Ibid.

65 Secretary Peters, *January 2001 Report*, p.2.

66 Seena Simon, "C-5 Spare-Parts System to be Privatized," *Air Force Times*, January 22, 2001, p. 10.

67 Secretary Peters, *January 2001 Report*, p.3.

available because the system had automatically eliminated them from the parts stocks.⁶⁸ The Air Force is now aware of this problem and working to correct it, but it will now take time to re-manufacture many of those parts whose usage the old system was unable to properly monitor.

In real terms, the funding shortfalls and funding decisions made by parts managers meant that more expensive, lower demand items were ordered only once they were broken and replacement parts were often disposed of too soon. This added to the long waiting times to get a part because parts often had to be made and delivered and that whole process was usually started too late to fill immediate repair needs.

Maintenance System Changes and Management Failures

The final factor in C-5 parts shortages has been maintenance system changes that were not entirely successful and management failures. In the 1990s, in an effort to reduce operating costs, the Air Force changed from three-level maintenance to two-level maintenance. Meaning that the amount of work done at the “third level”, or home bases, was reduced and most maintenance work is done in centralized depots and repair shops. Essentially, when there was three-level maintenance, bases were able to repair many parts on their own without sending those parts back to a central depot to be repaired and then sent back to the base to use to repair aircraft. While there was a logical rationale for this change at the time, so far the workload transfer has not provided the results expected.

*Under two-level maintenance, operating units no longer make repairs at the base level. Instead, spares parts are sent back to depots for repair, receiving a repaired part in return for a defective part. Theoretically, the combination of fewer inventory points and better transportation would reduce the requirement for spare inventories. In fact, efficiency gains were much lower than projected, with the result that the Air Force inventory system has been short of spare parts for some time.*⁶⁹

Not only were the expected efficiency gains lower than expected, they were exacerbated by changes that were happening simultaneously in the depots. Following the 1995 Base Realignment and Closure decisions to close McClellan Air Force Base in Sacramento, California and to realign Kelly Air Force Base in San Antonio, Texas, depots were consolidated. Workloads were moved to the Ogden,

68 Ibid.

69 General Ryan and Secretary Peters, *Posture Statement 2000*, p. 50.

Warner-Robins, and Oklahoma City Air Logistics Centers. Those workload transitions did not go as smoothly as planned.

In particular, Secretary Peters has said that the spare parts repairs workload was a difficult transition.⁷⁰ Equipment used at Sacramento had to be disassembled, crated, and moved from California to Utah. Once in Utah, it had to be reassembled, tested, and calibrated. The original schedule for all of that was overly optimistic. Ogden was not able to start doing the job of repairing spare parts as quickly as planned and Sacramento was no longer doing the job for a longer period of time than planned. This caused MICAP rates to increase dramatically. (MICAP stands for Mission Capable. Parts that are ordered as MICAP are high-priority parts needed to make an aircraft mission capable. MICAP rates show the total hours a maintenance technician waits for all the parts that have been ordered to fix an aircraft).

*Starting in August 1999 and continuing through January, transition problems produced some 100,000 MICAP hours over and above MICAPs related to other parts, an increase of almost 20 percentThe impact of these additional MICAP hours has been a decline in readiness. . . .Furthermore, the C-5 related MICAP rate has increased over the last two quarters by 36 percent. We believe that these decreases in readiness are primarily due to workload transitions.*⁷¹

In addition to the problems involved in moving equipment, fully staffing for the new workloads was a problem. When workloads were transferred, the largely civilian workforces in Sacramento and San Antonio did not always follow. This has meant depot backlogs due to parts shortages have been further exacerbated by shortages of experienced personnel. The majority of the C-5 depot workforce has less than three years of experience working on the C-5.⁷²

Throughout the Air Force, there is a shortage of 5-level maintainers.⁷³ There are three categories -- 3-level, 5-level, and 7-levels -- and at each level, less supervision

70 F. Whitten Peters, Secretary of the Air Force, written testimony to Subcommittee on Readiness and Management Support, Senate Armed Services Committee, March 3, 2000, p. 6.

71 Ibid, pp. 6-7.

72 Draft C-5 Tiger Team results, as presented at the Airlift/AirTanker Association Convention, November 3, 2000.

73 Bruce Rolfsen, "Vanishing Breed of Mechanics Throws Wrench Into Maintenance," *Air Force Times*, December 18, 2000, p. 14.

and more supervising occurs. A 5-level maintainer, typically a senior airman or staff sergeant, spends a good deal of time supervising 3-level maintainers and is more likely to be deployed or sent to school. These mid-career positions are only filled at 75% today.⁷⁴ Ten-years ago these positions were 90% full.⁷⁵ This means that on the flight lines, you often have less experienced personnel working on increasingly complicated problems and their supervisors are increasingly overworked.

These experience shortages within the depots and on the flight lines have also contributed to the problems the depots have had in accomplishing the scheduled maintenance that they do on the C-5 fleet in the pre-planned time frame. It has been taking almost double the time planned.⁷⁶ There are other reasons for the schedule delays, of course, including the lack of needed parts even at the depots.

When items that could be repaired were not repaired on time and became backlogged, that multiplied the negative impacts of the inaccurate forecasting of parts needed for older aircraft and the inadequate funding to buy needed parts. Supply managers bought too few new parts, anticipating that a certain number would be available because of repairs. When those repaired parts were not available, money had already been spent on other items and was no longer available to buy more new parts.

For 1997, the GAO clearly identified Air Force forecasting and management problems as the major reason for parts shortages.

74 Ibid.

75 Ibid.

76 Draft C-5 Tiger Team results.

More specifically, the Air Force's supply management activity group's fiscal year 1997 budget underestimated funding requirements for the group's wholesale division by about \$500 million because (1) all inventory requirements were not included in the budget and (2) inventory requirements increased after the Air Force had developed its budget. As a result, the supply management group could finance only 82 percent of its fiscal year 1997 inventory requirements.⁷⁷

In its fiscal year 2000 budget document for the supply group, the Office of the Under Secretary of Defense (Comptroller) raised concerns about the readiness of all military services and cited a lack of spare parts as a major contributor to the decline in the mission capability of aircraft...the budget document raised concerns about the Air Force's ability to use this additional obligation [\$141.4 million for supply group to buy and repair inventory items] to purchase the correct inventory items.⁷⁸

The Air Force has several initiatives underway to correct these forecasting and management problems. In at least one comprehensive study, they appear to have done a thorough job analyzing management and process changes that are needed.⁷⁹ This is critical, because even if requirements are fully funded and aircraft are modernized, if the funds go to the wrong requirements or are poorly managed, C-5s will still lack necessary parts and the nation will be short the airlift it needs.

The causes of the parts shortages are multiple -- an aging aircraft, inadequate funding prioritization and purchasing decisions in the past, and maintenance system changes and management failures. Each of these causes must be addressed in order to solve the C-5 parts shortage problem.

⁷⁷ Henry L Hinton, Jr., Assistant Comptroller General, National Security and International Affairs Division, *Defense Inventory – Continuing Challenges in Managing Inventories and Avoiding Adverse Operational Effects*, testimony before the Subcommittee on Military Readiness, House Armed Services Committee, GAO/T-NSIAD-99-83, February 25, 1999, p. 6.

⁷⁸ Ibid, p. 7.

⁷⁹ Draft C-5 Tiger Team results.

Chapter IV:

Some Improvements, But More Needs To Be Done

Some efforts are underway right now to fix the C-5 parts shortage. Not all are focused exclusively on the C-5, but all should benefit the C-5 as the interwoven military-wide parts systems are improved. One obvious and immediate effort has been to provide increased funding for parts. Another critical initiative is to try to fix the management of the parts supply process for the C-5 and defense-wide. Last, there is no doubt that on-going and planned C-5 modernization programs are essential to stabilizing and reducing the high demand for parts.

Increased Funding Provided

From 1997 to 2000, Congress has increased funding for parts across all of the services. In the 1999 budget, Congress increased spare parts funding by \$194 million. In the 2000 budget, the increase was \$85 million.⁸⁰ Added to that was \$387 million of parts funding included in the Kosovo Supplemental.⁸¹ The Air Force and the Department of Defense (DoD) have committed to Congress that they are using this money to fix the shortfall that had developed when parts were underfunded.⁸²

In addition, while addressing the parts shortages that already exist, they are working

80 Major General Larry D. Northington, Deputy Assistant Secretary (Budget) for the Air Force, written testimony before the Subcommittee on Readiness and Management Support of the Senate Armed Services Committee, March 7, 2000, p. 5.

81 The Kosovo Supplemental refers to the Fiscal Year 1999 Emergency Supplemental Appropriations bill, P.L. 106-31, signed into law May 21, 1999. This bill provided funds for hurricane assistance in Central America, to support the Wye Peace Agreement, for farmers in need of assistance, and for military operations over Kosovo.

82 General Lyles, p. 3.

to ensure that new shortages are not created. In the 2000 and 2001 budget requests, the Air Force fully funded the existing requirement for spare parts.⁸³

According to Air Force leadership, there is evidence that this increased funding is starting to stabilize the spare parts shortages throughout the Air Force, but the job is far from done. As Major General Northington, Deputy Assistant Secretary (Budget) for the Air Force, pointed out,

*Recent evidence suggests spares related mission-capable rates may be stabilizing. However, we must recognize that the average age of our aircraft will continue to increase for the foreseeable future, even with planned modernization of the fleet. We must therefore expect significant spares investments for a long time to come.*⁸⁴

It is critical that the proper funding levels for spare and repair parts be part of the budget every year. This is an area that requires constant diligence because it takes very little time for low funding in this account to translate into lower readiness and morale.

Management Initiatives

In addition to increased funding, Congress must continue to pay close attention to Air Force and DoD efforts to improve the C-5 support and to improve the military's overall logistics efforts and parts management.

Specific to the program management of C-5 support, Secretary Peters formed a multi-command team of cross-functional C-5 experts to look at possible improvements in logistics and operational maintainability, the C-5 Tiger Team.⁸⁵ In June of 2000, field teams visited Travis Air Force Base and in July they visited Dover Air Force Base. This team has provided a series of recommendations.⁸⁶ The results indicate that the Team did a thorough and comprehensive review of existing

83 Ibid.

84 Major General Northington, p. 5.

85 F. Whitten Peters, Secretary of the Air Force, letter to Senator Biden of June 6, 2000, p. 1. The full text of the letter is included in the Appendix.

86 Colonel James Russell, Air Mobility Command Headquarters Logistics Group, "C-5 Tiger Team Findings," briefing to Biden staff, Scott Air Force Base, March 13, 2001.

management and systemic problems in support of the C-5. In addition, they provided recommendations for immediate and long-term improvements. This is a welcome step recognizing that the problem must be addressed comprehensively – that we cannot afford to ignore any portion of the support system that limits access to a critical military asset like the C-5.

In order to make sure that these efforts produce the improvements needed, in the 2001 Defense Authorization bill, I authored legislation that requires the Secretary of the Air Force to provide two reports in 2001 on the exact situation of C-5 parts shortages, what is being done to fix the problem, and what the impacts of the problem are for personnel readiness and retention.⁸⁷

Just focusing on the C-5 support program is not enough, however. It is also important to look at the larger Air Force and defense-wide logistics systems that support and interact with specific weapons support programs. For the past decade, reform of the defense logistics system and the individual services logistics systems has been a goal. Quite simply, making logistics more efficient and less costly is a difficult task. Unfortunately, not all of the various reform efforts that have been tried have worked. In addition, as the military moved through the 1990s, the focus of its logistics reform changed.

Originally, lowering cost and reducing excess inventory was a logical focus, following post-Cold War downsizing of the overall force. Those efforts were not entirely successful and had the secondary effect of adding to the shortfall of aviation parts in particular.

*Since 1986, the Air Force reduced its aircraft inventory by 40%. Quite naturally, the inventory of spare parts supporting those aircraft also shrunk. Both Congress and OSD [Office of the Secretary of Defense] strongly encouraged the Services to eliminate excess inventory. But the downsizing was not well managed and has led to some of today's spares shortfalls. . . . Pressure to reduce inventory and restrict new procurement, although well intended, seriously impacted Air Force spare and repair parts availability. The impact on jet engine support was most severe.*⁸⁸

More recently, the reform focus has expanded. The Air Force established a new

87 Full text of amendment and Biden speech accompanying its passage are included in the Appendix, along with the first report submitted in January 2001.

88 General Babbit, written testimony, pp. 1-2.

Agile Logistics program, with the overarching goal of increased operational efficiency and reduced cost. Increased operational efficiency now includes much more than just lowering inventory stocks. This is clear from the three primary initiatives now underway that underpin the Agile Logistics program -- the depot repair enhancement initiative, the aircraft repair enhancement initiative, and the contract repair enhancement initiative. These initiatives are supposed to do the following: provide better service to depot customers by reducing repair turnaround times, reducing supply inventories and costs, prioritizing repairs appropriately, and providing spare parts rapidly.

In a report issued in June of 1999, the General Accounting Office (GAO) evaluated these Air Force initiatives and other efforts since 1994 by both the Air Force and DoD to improve depot-level maintenance.⁸⁹ Unfortunately, while it is clear that the Air Force and DoD are paying attention to the underlying systemic problems that are creating parts shortages, GAO concluded that there is a long way to go.

*The Air Force did not establish clear and consistent measures to facilitate tracking progress and measuring the success of the initiatives. Thus, it cannot conclusively determine whether the goals of the Agile Logistics program. . .are being achieved. However, limited information indicates that the initiatives have been implemented piecemeal and have had mixed results. . . .key management changes, including the addition of measures for determining the achievement of initiative goals, could facilitate implementation of the initiatives and provide for clearer evaluation of the implementation.*⁹⁰

Congress must continue to work with the military to make sure that systemic solutions are found. GAO's review and the findings of the C-5 Tiger Team point the way to some of the steps that must be taken. Until the interwoven logistics systems of the military services and the Defense Logistics Agency are actually operating effectively and efficiently, it will be hard to eliminate the parts problem for the C-5 and other platforms.

Modernization Vital

In the near and long term, the parts shortage must also be addressed from the

89 General Accounting Office (GAO), *Air Force Depot Maintenance: Management Changes Would Improve Implementation of Reform Initiatives*, Report to Congressional Requesters, GAO-NSAID-99-63, June 1999, p. 10.

90 Ibid, p. 18.

demand side as well. Stabilizing and lowering the demand for C-5 parts can only happen if the C-5 is properly modernized. The Air Force has three major modernization programs underway to reduce the maintenance needs and cost of operating the C-5 – the Avionics Modernization Program (AMP), the High Pressure Turbine Replacement (HPT), and the Reliability Enhancement and Re-engining Program (RERP).

The Avionics Modernization Program is important for two reasons. One, older avionics systems require more time and parts to maintain. Air Mobility Command anticipates that AMP upgrades will increase the average time between failure for these systems ten-fold.⁹¹ In addition, some of the systems being replaced used technology that was not entirely reliable, like the autopilot currently on the C-5. The new autopilot uses highly reliable digital technology. In addition to reducing maintenance demands, these technology upgrades also reduce the workload for the pilots.⁹²

Two, the AMP will enhance safety and provide new capabilities that are needed to operate in more crowded international airspace. Those needs are part of compliance with new Global Air Traffic Management regulations. Planes that are not compliant will not have access to high density areas like Europe and will not be able to use optimal air routes. This reduces America's global reach and makes operating the C-5 fleet more costly.

Secretary Peters explained the importance of AMP succinctly when discussing whether or not the entire fleet of C-5s needed to be included in the program,

The Avionics Modernization Program (AMP) is critical for flight safety, rapid mobility response and worldwide global access. Without the AMP modification, mandated critical safety equipment (Traffic Alert and Collision Avoidance System/Terrain Awareness and Warning System) will not be available on the 76 C-5As. Additionally, this will impact the ability of the C-5As to operate around the world within Global Air Traffic Management (GATM) airspace. AMP is designed to

91 Air Mobility Command, *Air Mobility Strategic Plan 2000*, cd-rom.

92 Ibid.

*ensure the C-5 is GATM compliant.*⁹³

The second major modernization program is the replacement of high pressure turbines on the TF-39 engines. This is an on-going program that should be completed in 2003. The high pressure turbine is the leading cause of engine removal from the aircraft wing for repair or maintenance. Currently, the TF-39 averages only 1,200 hours on a C-5 wing before needing to be taken-off.⁹⁴ This is absurdly low compared to modern jet engines which average 8,000 to 12,000 hours on wing before requiring removal for maintenance.⁹⁵ High pressure turbine replacements literally double the TF-39's time on the wing. They also pay for themselves in three-and-a-half years.⁹⁶ Replacing the high pressure turbines does not, however, fix all of the other problems in the 40 year old technology of the TF-39. It is merely a stop-gap measure until the Reliability Enhancement and Re-engining Program (RERP) is completed.

The RERP is the final and most critical modernization planned for the C-5 fleet. It is expected to take 14 years to complete, in part because the C-5 fleet is always in use and only a few planes can be upgraded at any given time, and it will cost between \$45 million and \$63 million per plane.⁹⁷ It is a comprehensive plan to address the "bad actors," or parts/subsystems that are most prone to breaking, on the C-5. As mentioned, the old TF-39 engines are the cause of 20% of the C-5's not

93 Secretary Peters, letter to Senator Biden of June 6, 2000, p. 2. The full text of the letter is included in the Appendix.

94 General Robertson, "Global Mobility – The Keystone to America's Defense Strategy," p.62.

95 Ibid.

96 Air Mobility Command, *Air Mobility Strategic Plan*, cd-rom.

97 Estimates have varied. These figures are based on discussions with Lockheed-Martin representatives in September 2000 (Lockheed is the primary contractor for the RERP), from information supporting the President's budget request for Fiscal Year 2001, and from meetings with Air Mobility Command staff at Scott Air Force base in March 2001. In last year's budget request, the total program cost was \$5.63 billion. More recently, the Air Force estimates that the total program cost for the entire fleet will be \$7.9 billion. This includes about \$280 million for development and testing costs. The total program cost varies due to requirement changes and schedule delays. For that reason, it is more realistic in the early stages of the program to use the cost range.

mission capable time.⁹⁸ New and modern engines will be much easier to maintain and much more reliable. In addition, these commercial off-the-shelf engines will provide increased take-off thrust, reduced fuel consumption, and stage three noise compliance (increasingly important in high traffic areas like Europe and the Pacific).⁹⁹

The additional power in the new engines, expected to be a 22% increase over the current amount, will allow C-5s to carry more cargo when operating in hot climates like Kuwait.¹⁰⁰ It will also make it possible to climb more quickly, which is necessary to access the optimal air routes.

In addition to new engines, this program includes upgrades to other critical systems – auxiliary power units, electrical systems, hydraulic systems, fuel systems, fire suppression systems, pressurization/air conditions systems, and landing gear.¹⁰¹ All of this is expected to lead to over a billion dollars in operations and maintenance costs.¹⁰² In addition, the only way to meet the requirements established by the Mobility Requirements Study 2005 is by raising the mission capable rates of the C-5. All of the options in that study presume C-5 mission capable rates of at least 65% and as high as 80%.¹⁰³ Given the 2000 mission capable rates for the fleet – 56.2% to 61.3%, it is hard to imagine getting there from here without RERP.¹⁰⁴

General Robertson stated the importance of this program clearly,

The Air Force's Requirements Oversight Council and Joint Staff's Joint

98 Air Mobility Command, *Air Mobility Strategic Plan* , cd-rom.

99 Major General Arthur Lichte, "The C-5 Galaxy: Engine Analysis."

100 Air Mobility Command, *Air Mobility Strategic Plan* , cd-rom.

101 Ibid.

102 Major General Williams, "Mobility Modernization".

103 Joint Chiefs of Staff, *MRS-05 Executive Summary*, p. 5.

104 Secretary Peters, *January 2001 Report*, p. 4.

*Requirements Board approved a range of recommendations to enhance C-5 maintenance reliability and to meet cargo delivery shortfalls. Their assessment, based on engineering studies (as well as field experience), have agreed that reengining the C-5 fleet is the most important thing we can do if we are to bring the system to our desired 75% mission capable rate while simultaneously meeting the emerging outsize/oversize requirements we see coming out of Mobility Requirement Study 2005.*¹⁰⁵

The only way to reduce the amount of old and hard-to-get parts needed for the C-5 is to modernize it. The only way to reduce operating and maintenance costs is to install modern engines and technology.

There is no doubt that America's military will continue to need the C-5's airlift for the foreseeable future. In the near term, the most affordable way to keep this capability is to fully modernize the 126 planes in the C-5 fleet. It is essential, therefore, that all of three modernization programs – the Avionics Modernization Program, the High-Pressure Turbine Replacement, and the Reliability Enhancement and Re-engining Program – be fully funded and completed as quickly as possible. They are affordable and necessary to America's ability to promote a stable global environment.

¹⁰⁵ General Charles T. Robertson, Commander in Chief of United States Transportation Command, letter to Senator Biden, June 8, 2000, p.1. The full text of the letter is included in the Appendix.

Chapter V:

Conclusion

As I said in the beginning, it is hard to underestimate the importance of the C-5 to America's national security strategy. The C-5 gives the United States a unique capability to project military force and humanitarian assistance around the world. No other nation has the heavy airlift capability that we have. For the foreseeable future, our need for strategic, heavy airlift will continue to grow.

Unfortunately, that heavy airlift is at risk because of C-5 parts shortages. Those parts shortages endanger C-5 missions. They also lower morale as maintainers are forced to work double-to-triple manhours because cannibalization has become a standard operating procedure. The parts shortages also lower mission readiness as training becomes more limited and planes are increasingly Not Mission Capable.

We know a good deal about why C-5 parts shortages exist. The C-5 is an aging aircraft. Forecasting parts needs for older planes, particularly for older jet engines, is difficult. In addition, several years of under funding for parts throughout the Air Force and Department of Defense impacted inter-related support systems and added to the parts shortage. Last, efforts to reform the logistics system in the Air Force and Department of Defense created some unexpected transition difficulties and is far from complete.

None of those causes can be removed quickly. There are no short term answers. We know that some of the pieces of the solution include:

- increased and predictable parts funding,
- complete modernization of the entire C-5 fleet (including the High-Pressure Turbine Replacement, the Avionics Modernization Program, and the Reliability Enhancement and Re-engining Program), and
- continued management reform throughout the logistics system.

As we move forward with defense planning this year, on-going studies and experienced personnel will suggest other pieces and initiatives. The ones I have mentioned are both practical and affordable. The Administration and Congress must work together to ensure that these parts of the comprehensive solution are supported and funded.

We cannot forget that constant diligence is required now, and in the future, to make sure our nation's ability to project power is not imperiled by something as basic as a missing widget.

Logistics support for any military system isn't necessarily glamorous, but in the case of the C-5, it is essential. America's ability to promote its interests around the world depends upon it.

APPENDIX:

- **Secretary Peters' July 6, 2000 letter to Senator Biden**
- **Biden Amendment Text – Requiring Air Force Reports on C-5 Parts**
- **Statement on Biden Amendment**
- **January 2001 Report submitted to Congress**
- **General Robertson's June 8, 2000 letter to Senator Biden**
- **Glossary of Terms and Acronyms**

GLOSSARY of TERMS and ACRONYMS¹⁰⁶

Airlift Capability – The total capacity expressed in terms of number of passengers and/or weight/cubic displacement of cargo that can be carried at any one time to a given destination by available airlift.

Airlift Requirement – The total number of passengers and/or weight/cubic displacement of cargo required to be carried by air for a specific task.

Air Mobility Command – AMC – The Air Force Component Command of the US Transportation Command.

Cannibalize – To remove serviceable parts from one item of equipment in order to install them on another item of equipment.

Combatant Command – A unified or specified command with a broad continuing mission under a single commander established and so designated by the President, through the Secretary of Defense and with the advice and assistance of the Chairman of the Joint Chiefs of Staff. Combatant commands typically have geographic or functional responsibilities.

Commander in Chief – CINC – Commander of a combatant command.

Full Mission Capable – FMC – Material condition of an aircraft or training device indicating that it can perform all of its missions.

Intertheater – Between theaters or between the continental United States and theaters.

Intertheater airlift – See strategic airlift.

Intratheater – Within a theater.

¹⁰⁶ Unless otherwise noted, all definitions are from Joint Pub 1-02, *Department of Defense Dictionary of Military and Associated Terms*, Joint Terminology Master Database as of 10 June 1998.

Intratheater airlift – See theater airlift.

MICAP¹⁰⁷ – Mission Capable status used for ordering a part. The MICAP rate measures the total hours a maintenance technician waits for all the parts that have been ordered to fix an aircraft.

Mission Capable – MC – Material condition of an aircraft indicating it can perform at least one and potentially all of its designated missions. Mission capable is further defined as the sum of full mission capable and partial mission capable.

National Command Authorities – NCA – The President and the Secretary of Defense or their duly deputized alternates or successors.

Not Mission Capable, Maintenance – NMCM – Material condition indicating that systems and equipment are not capable of performing any of their assigned missions because of maintenance requirements.

Not Mission Capable, Supply – NMCS – Material condition indicating that systems and equipment are not capable of performing any of their assigned missions because of maintenance work stoppage due to a supply shortage.

Partial Mission Capable – PMC – Material condition of an aircraft or training device indicating that it can perform at least one but not all of its missions.

Partial Mission Capable, Maintenance – PMCM – Material condition of an aircraft or training device indicating that it can perform at least one but not all of its missions because of maintenance requirements existing on the inoperable subsystem(s).

Partial Mission Capable, Supply – PMCS – Material condition of an aircraft or training device indicating that it can perform at least one but not all of its missions because maintenance required to clear the discrepancy cannot continue due to a supply shortage.

Strategic Airlift – The common user airlift linking theaters to the continental United States (CONUS) and to other theaters as well as the airlift within CONUS. These airlift assets are assigned to the Commander in Chief, United States Transportation Command. Due to the intertheater ranges usually involved, strategic airlift is normally comprised of the heavy, longer range, intercontinental airlift assets but may be augmented with shorter range aircraft when required.

¹⁰⁷ Based on Secretary Peters' written explanation in testimony before the Senate Armed Services Committee's Subcommittee on Readiness and Management Support, 3 March 2000, p. 5.

Theater – The geographical area outside the continental United States for which a commander of a combatant command has been assigned responsibility.

Theater Airlift – The airlift assigned or attached to a combatant commander other than the Commander in Chief, United States Transportation Command, which provides air movement and delivery of personnel and equipment directly into objective areas through air landing, airdrop, extraction, or other delivery techniques; and the air logistic support of all theater forces, including those engaged in combat operations, to meet specific theater objectives and requirements.

United States Transportation Command – USTRANSCOM – The unified command with the mission to provide strategic air, land, and sea transportation for the Department of Defense, across the range of military operations.

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